

WHAT IS CLAIMED IS:

1. A transfer apparatus comprising:
 - a belt that rotates and carries either one of a plurality of images directly and a recording material with a plurality of images, a scale is
 - 5 provided along at least one side of a portion of the belt;
 - a sensor that reads the scale on the belt to obtain scale information;
 - an actual speed calculating unit that calculates a speed of the belt from the scale information;
 - 10 a speed calculating unit that calculates a speed of the belt from information other than the scale information; and
 - a control unit that provides a control to correct speed of the belt according to the speed calculated.
- 15 2. The transfer apparatus according to claim 1, further comprising a motor that rotates the belt, and a speed detector that detects number of revolutions of the motor, wherein
 - the speed calculating unit calculates the speed of the belt from the number of revolutions of the motor detected by the speed detector.
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3. The transfer apparatus according to claim 2, further comprising:
 - a drive roller that rotatably supports the belt and drives the belt, torque of the motor is transmitted to the drive roller; and
 - a frictional force increasing unit, provided on a surface of the
 - 25 drive roller, that obtains a nonskid surface of the drive roller with

respect to the belt.

4. The transfer apparatus according to claim 1, further comprising
a driven roller that rotatably supports the belt, and a speed detector that
5 detects number of revolutions of the driven roller, wherein

the speed calculating unit calculates the speed of the belt from
the number of revolutions of the driven roller detected by the speed
detector.

- 10 5. The transfer apparatus according to claim 2, wherein the speed
detector is an encoder.

6. The transfer apparatus according to claim 4, wherein the speed
detector is an encoder.

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7. The transfer apparatus according to claim 1, further comprising
an abnormal operation deciding unit that decides whether the speed of
the belt calculated by the actual speed calculating unit is abnormal, and

- the control unit provides the control to correct the speed of the
20 belt based on the speed calculated by the speed calculating unit when
the abnormal operation deciding unit decides that the speed of the belt
calculated by the actual speed calculating unit is abnormal.

8. The transfer apparatus according to claim 1, wherein the control unit provides the control to correct the speed of the belt according to a difference between the speed calculated by the actual speed calculating unit and a predetermined target speed.

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9. The transfer apparatus according to claim 1, wherein the control unit provides the control to correct the speed of the belt according to a combined value obtained by adding a first speed difference and a second speed difference, wherein the first speed difference is a difference between the speed of the belt calculated by the actual speed calculating unit and a predetermined target speed, and the second speed difference is a difference between the speed of the belt calculated by the speed calculating unit and the target speed.

10. The transfer apparatus according to claim 9, further comprising an abnormal operation deciding unit that decides whether the speed of the belt calculated by the actual speed calculating unit and the speed of the belt calculated by the speed calculating unit are abnormal, wherein the control unit corrects the speed of the belt according to the combined value when the abnormal operation deciding unit decides that the speed of the belt calculated by the actual speed calculating unit and the speed of the belt calculated by the speed calculating unit are normal.

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11. The transfer apparatus according to claim 10, wherein the control unit provides a control to correct the speed of the belt according to the combined value when the first speed difference exceeds a predetermined value.

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12. The transfer apparatus according to claim 1, wherein the speed calculating unit includes at least two sub-speed calculating units each of which calculates speed of the belt based on different pieces of information obtained from different detection locations.

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13. The transfer apparatus according to claim 12, further comprising an abnormal operation deciding unit that decides whether the speed of the belt calculated by the actual speed calculating unit is abnormal, and the control unit provides the control to correct the speed of the belt according to the speeds of the belt calculated by the sub-speed calculating units when the abnormal operation deciding unit decides that the speed of the belt calculated by the actual speed calculating unit is abnormal.

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14. The transfer apparatus according to claim 13, further comprising:

a sub-speed calculating unit selector that selects a sub-speed calculating unit from among the sub-speed calculating units whose speed is to be used by the control unit in controlling the speed of the

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belt based on a distance between the belt and the detection location of

each of the sub-speed calculating unit.

15. The transfer apparatus according to claim 14, further comprising:

5 a sub-speed calculating unit selector that selects a sub-speed calculating unit from among the sub-speed calculating units whose speed is to be used by the control unit in controlling the speed of the belt based on a distance between an intermediate transfer belt as the belt and the detection location of each of the sub-speed calculating unit.

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16. The transfer apparatus according to claim 1, further comprising:
a belt-speed-control stopping unit that inhibits control to correct the speed of the belt by the control unit when a single color image is formed.

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17. A transfer apparatus comprising:

a belt that rotates by torque of a motor as a stepping motor and carries either one of a plurality of images directly and a recording material with a plurality of images, a scale is provided along at least one side of entire of the belt;

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a sensor that reads the scale on the belt to obtain scale information;

an actual speed calculating unit that calculates a speed of the belt from the scale information;

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an abnormality detection unit that decides whether the speed of

the belt detected by the actual speed calculating unit is abnormal;

a control unit that provides a control to correct speed of the belt according to the speed calculated; and

a motor control unit that, when the abnormality detection unit
5 decides that the speed of the belt detected by the actual speed
calculating unit is abnormal, invalidates correction of the speed of the
belt by the control unit and controls the stepping motor to rotate at a
predetermined target speed.

10 18. The transfer apparatus according to claim 17, further comprising
a speed calculating unit that calculates a speed of the belt from
information other than the scale information.

19. The transfer apparatus according to claim 18, further comprising
15 a driven roller that rotatably supports the belt, and a speed detector that
detects number of revolutions of the driven roller, wherein
the speed calculating unit calculates the speed of the belt from
the number of revolutions of the driven roller detected by the speed
detector.

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20. The transfer apparatus according to claim 19, further comprising
a frictional force increasing unit, provided on surface of the driven roller,
that obtains a nonskid surface of the driven roller with respect to the
belt.

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21. The transfer apparatus according to claim 19, wherein the speed detector is an encoder.

22. The transfer apparatus according to claim 18, further comprising
5 an abnormal operation deciding unit that decides whether the speed of the belt calculated by the actual speed calculating unit is abnormal, and the control unit provides the control to correct the speed of the belt based on the speed calculated by the speed calculating unit when the abnormal operation deciding unit decides that the speed of the belt
10 calculated by the actual speed calculating unit is abnormal.

23. The transfer apparatus according to claim 17, further comprising an abnormal operation deciding unit that decides whether the speed of the belt calculated by the actual speed calculating unit is abnormal,
15 wherein

the control unit provides the control to correct the speed of the belt according to a difference between the speed of the belt calculated by the actual speed calculating unit and a predetermined target speed when the abnormal operation deciding unit decides that the speed of
20 the belt calculated by the actual speed calculating unit is abnormal.

24. The transfer apparatus according to claim 18, wherein the control unit provides the control to correct the speed of the belt according to a combined value obtained by adding a first speed
25 difference and a second speed difference, wherein the first speed

difference is a difference between the speed of the belt calculated by the actual speed calculating unit and a predetermined target speed, and the second speed difference is a difference between the speed of the belt calculated by the speed calculating unit and the target speed.

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25. The transfer apparatus according to claim 9, further comprising an abnormal operation deciding unit that decides whether the speed of the belt calculated by the actual speed calculating unit and the speed of the belt calculated by the speed calculating unit are abnormal, wherein

10 the control unit corrects the speed of the belt according to the combined value when the abnormal operation deciding unit decides that the speed of the belt calculated by the actual speed calculating unit and the speed of the belt calculated by the speed calculating unit are normal.

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26. The transfer apparatus according to claim 25, wherein the control unit provides a control to correct the speed of the belt according to the combined value when the first speed difference exceeds a predetermined value.

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27. The transfer apparatus according to claim 18, wherein the speed calculating unit includes at least two sub-speed calculating units each of which calculates speed of the belt based on different pieces of information obtained from different detection locations.

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28. The transfer apparatus according to claim 27, further comprising an abnormal operation deciding unit that decides whether the speed of the belt calculated by the actual speed calculating unit is abnormal, wherein

5 the control unit provides the control to correct the speed of the belt according to the speeds of the belt calculated by the sub-speed calculating units when the abnormal operation deciding unit decides that the speed of the belt calculated by the actual speed calculating unit is abnormal.

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29. The transfer apparatus according to claim 28, further comprising:

a sub-speed calculating unit selector that selects a sub-speed calculating unit from among the sub-speed calculating units whose
15 speed is to be used by the control unit in controlling the speed of rotation of the belt based on a distance between the belt and the detection location of each of the sub-speed calculating unit.

30. The transfer apparatus according to claim 29, further
20 comprising:

a sub-speed calculating unit selector that selects a sub-speed calculating unit from among the sub-speed calculating units whose speed is to be used by the control unit in controlling the speed of the belt based on a distance between an intermediate transfer belt as the
25 belt and the detection location of each of the sub-speed calculating unit.

31. The transfer apparatus according to claim 19, further comprising an abnormal operation deciding unit that decides whether the speed of the belt calculated by the actual speed calculating unit and the speed of the belt calculated by the speed calculating unit are abnormal, wherein

5 the motor control unit provides a control to rotate the stepping motor at a predetermined target speed when the abnormal operation deciding unit decides that the speed of the belt calculated by the actual speed calculating unit and the speed of the belt calculated by the speed calculating unit are abnormal.

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32. The transfer apparatus according to claim 19, further comprising:

a belt-speed-control stopping unit that inhibits control to correct the speed of the belt by the control unit when a single color image is
15 formed.

33. An image forming apparatus comprising a transfer apparatus, the transfer apparatus including

a belt that rotates and carries either one of a plurality of images
20 directly and a recording material with a plurality of images, a scale is provided along at least one side of a portion of the belt;

a sensor that reads the scale on the belt to obtain scale information;

an actual speed calculating unit that calculates a speed of the
25 belt from the scale information;

a speed calculating unit that calculates a speed of the belt from information other than the scale information; and

a control unit that provides a control to correct speed of the belt according to the speed calculated.

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34. The image forming apparatus according to claim 33, further comprising an abnormality occurrence display unit that causes an external display unit to display notice indicating that the speed of the belt calculated by the actual speed calculating unit is abnormal when

10 the speed of the belt calculated by the actual speed calculating unit is abnormal.

35. An image forming apparatus comprising a transfer apparatus, the transfer apparatus including

15 a belt that rotates by torque of a motor as a stepping motor and carries either one of a plurality of images directly and a recording material with a plurality of images, a scale is provided along at least one side of entire of the belt;

a sensor that reads the scale on the belt to obtain scale
20 information;

an actual speed calculating unit that calculates a speed of the belt from the scale information;

an abnormality detection unit that decides whether the speed of the belt detected by the actual speed calculating unit is abnormal;

25 a control unit that provides a control to correct speed of the belt

according to the speed calculated; and

a motor control unit that, when the abnormality detection unit decides that the speed of the belt detected by the actual speed calculating unit is abnormal, invalidates correction of the speed of the belt by the control unit and controls the stepping motor to rotate at a predetermined target speed.

36. The image forming apparatus according to claim 35, further comprising an abnormality occurrence display unit that causes an external display unit to display notice indicating that the speed of the belt calculated by the actual speed calculating unit is abnormal when the abnormality detection unit decides that the speed of the belt detected by the actual speed calculating unit is abnormal.

37. A method of correcting a speed of a belt, comprising:
reading a scale on the belt to obtain scale information, the belt being rotatable and carries either one of a plurality of images directly and a recording material with a plurality of images, a scale is provided along at least one side of a portion of the belt;
calculating a speed of the belt from the scale information;
calculating a speed of the belt from information other than the scale information;
controlling the speed of the belt according to the speed calculated.

38. The method according to claim 37, further comprising deciding whether the speed calculated from the scale information is normal, wherein

the controlling includes controlling the speed of the belt
5 according to a difference between the speed calculated from the scale information and a predetermined target speed when it is decided at the deciding that the speed calculated from the scale information is normal.

39. The method according to claim 37, wherein the controlling
10 includes controlling the speed of the belt according to a combined value of a first speed difference and a second speed difference when the speed of the belt calculated from the scale information and the speed of the belt calculated from information other than the scale information are normal but the first speed difference exceeds a predetermined value,
15 wherein the first speed difference is a difference between the speed of the belt calculated from the scale information and a predetermined target speed, and the second speed difference is a difference between the speed of the belt calculated from information other than the scale information.

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40. The method according to claim 37, wherein the calculating the speed of the belt from information other than the scale information includes

calculating speeds of the belt based on at least two different
25 pieces of information obtained from different detection locations; and

deciding a speed of the belt, from among the speeds of the belt calculated based from at least two different pieces of information, that corresponds to a detection location that is closest to the belt as the speed of the belt that is to be used at the controlling.

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41. A method of correcting a speed of a belt, comprising:

reading a scale on the belt to obtain scale information, the belt being rotated by a stepping motor and carries either one of a plurality of images directly and a recording material with a plurality of images, a

10 scale is provided along at least one side of entire of the belt;

calculating a speed of the belt from the scale information;

deciding whether the speed of the belt calculated from the scale information is abnormal; and

controlling the speed of the belt based on the speed of the belt
15 calculated from the scale information when it is decided at the deciding that the speed of the belt calculated from the scale information is normal, and controlling speed of rotation of the stepping motor so as to be substantially same as a predetermined target speed when it is decided at the deciding that the speed of the belt calculated from the
20 scale information is abnormal.

42. A method of correcting a speed of a belt, comprising:

reading a scale on the belt to obtain scale information, the belt being rotated by a stepping motor and carries either one of a plurality of
25 images directly and a recording material with a plurality of images, a

scale is provided along at least one side of entire of the belt;

calculating a speed of the belt from the scale information;

calculating a speed of the belt from information other than the scale information;

- 5 deciding whether the speed of the belt calculated from the scale information and the speed of the belt calculated from the information other than the scale information are abnormal; and

controlling the speed of the belt based on the speed of the belt calculated from the scale information when it is decided at the deciding

- 10 that the speed of the belt calculated from the scale information is normal, controlling the speed of the belt based on the speed of the belt calculated from the information other than the scale information when it is decided at the deciding that the speed of the belt calculated from the scale information is abnormal, and controlling speed of the stepping

- 15 motor so as to be substantially same as a predetermined target speed when it is decided at the deciding that the speed of the belt calculated from the scale information and the speed of the belt calculated from the information other than the scale information are abnormal.